

SULLIVAN LAKE, LARGEMOUTH BASS POPULATION ESTIMATE

Sullivan County

2006 Fish Management Report

David S. Kittaka

Fisheries Biologists



Fisheries Section  
Indiana Department of Natural Resources  
Division of Fish and Wildlife  
I.G.C. South, Room W273  
402 W. Washington Street  
Indianapolis, Indiana 46204

2007

## EXECUTIVE SUMMARY

- A largemouth bass population estimate was conducted at Sullivan Lake, Sullivan County, April 25 to May 9, 2006. The purpose of this population estimate was to determine if a mark and recapture population estimate could be completed on a large lake through sub sampling of the population and expanding the estimate to account for areas not sampled. Data collected will determine largemouth bass population size, age and growth and total estimated mortality.
- A total of 1,919 bass was marked with a fin clip. There were 259 recaptures. The expanded population estimate for largemouth bass was 12,243 fish or 26.5 bass/acre. Population of stock size and above bass was 7,855 or 17.0 stock size bass/acre. Length range of bass collected was 4.9 to 20.5 in TL. Bass PSD was 46 and RSD-P was 8 (Anderson and Neumann 1996). The catch rate was 160 bass/h in 12 h of electrofishing.
- Validation of the expanded population method was completed by comparing data from an existing bass population estimate at Lenape Lake (Schoenung 2002). Sampling station data was randomly removed to compare similar percent of shoreline sampled during the Sullivan Lake survey. Results were close enough to fall within the standard error of the original survey.
- In the 2003 creel survey and bass sampling report, a recommendation was made to increase the minimum size limit to 16 in TL in hopes of increasing the number of larger size bass. Based upon 2003 and 2006 age data, bass mortality and exploitation was modeled to determine if a size limit change would drastically improve the number of larger bass. Results were a 24% decrease in bass harvest yield. A minimal increase in number of 16 in and greater bass was found (0.76 bass/acre to 0.9 bass/acre). There was not overwhelming support for a size limit increase in 2003 by all anglers as well as anglers that target bass. IDNR will not pursue a size limit increase for bass at Sullivan Lake.

## INTRODUCTION

Sullivan Lake is a 461-acre impoundment located near Sullivan, Indiana. The lake was constructed to provide flood control and recreation. The maximum depth is 25 ft while the average depth is about 10 ft. The Sullivan County Park Board maintains the lake and adjacent park. Public facilities at the lake include a campground, picnic area, beach, boat mooring docks, accessible fishing dock, and two boat ramps. There are also numerous private residences on the lake.

Sullivan Lake supports a typical warmwater fish community consisting of bluegill, largemouth bass, gizzard shad, and white crappie. During mid-summer, water quality is normally marginal to poor for coolwater species. Dissolved oxygen is usually absent below 7 ft throughout the summer months. Water temperatures at this depth can reach 85°F for sustained periods. Water transparency as measured with a Secchi disk is normally around 2 ft. These conditions limit the options available for supplemental predator stockings.

Fish management at Sullivan Lake is conducted by the Indiana Department of Natural Resources and has focused primarily on largemouth bass and panfish. A 14-in minimum size limit has been in effect for largemouth bass since 1976. To provide additional fishing opportunities and help utilize surplus forage fish, saugeye (walleye-sauger hybrids) were stocked each year from 1983 through present. Past studies showed both good survival of stocked saugeye and good returns to the creel (Schoenung 2001 and 2003).

The last survey in 2003 included an angler creel survey and spring largemouth bass sampling.

A largemouth bass population estimate was conducted April 25 to May 5, 2006. The purpose of this population estimate was to determine if a mark and recapture population estimate could be completed on a large lake through subsampling of the population and expanding the estimate to account for areas not sampled. Modeling the largemouth bass population for a size limit change was also investigated.

## METHODS

Because of the lake's size, a comprehensive shoreline sample for a mark and recapture population estimate was not feasible. A modified Schnabel mark and recapture method was used to estimate the largemouth bass population at Sullivan Lake (Kohler 1999). Prior to sampling, the lake shoreline was measured and ½ mi stations were designated. There were a total of 26 possible stations at Sullivan Lake. Eight stations were randomly picked for the east shore of the lake as well as eight stations on the west shore (Figure 1). A population estimate was created for the 16 stations and then expanded to encompass all 26 stations. Beginning April 25, all 16 stations were sampled once a week for three consecutive weeks. All bass collected were measured and marked once by removal of a fin. Marks were different from the east side (left pectoral clip) of the lake to the west side (left ventral clip) to determine if there was considerable movement of fish from week to week from the east to the west shore of the lake. Scale samples were taken for age and growth determination. All bass were collected with a DC pulsed electrofisher, utilizing two dippers.

A recommendation from the 2003 angler creel survey was to pursue a minimum size limit change for largemouth bass. In order to determine if this change would increase the number of 16 in and greater bass, angler creel information and bass data from 2003 and bass data from 2006 were analyzed using Fishery Analysis Simulation Tools software (FAST). Methods include; VonBertalanffy growth function, Beverton-Holt yield-per-recruit model and Slipke and Maceina calculation of natural mortality (Slipke and Maceina 2000).

## RESULTS AND DISCUSSION

A total of 1,919 bass was marked with a fin clip. There were 259 recaptures. Ten of these fish were recaptured from the opposite shore of their origin, indicating little movement of bass that time of year from one side to the other. Originally, bass tournaments that weigh in catches at a central location were a concern for moving fish in and out of sample sites. After three weeks of marking and documenting recaptures there was only one displaced fish that was legal size or greater. The standard error was 6.2 for the estimate of the total population. An acceptable standard error for mark recapture

population estimates is 10% or less. The total population estimate for the 16 sample stations was 6,995 bass. The population estimate for stock size bass (total of bass 8 in and greater) was 4,489 fish. The standard error was 7.0. The expanded population estimate for largemouth bass was 11,367 fish or 24.7 bass/acre. The population estimate of stock size and above bass was 7,295 or 15.8 stock size bass/acre. Bass collected ranged from 4.9 to 20.5 in TL (Figure 2). Bass PSD was 46 and RSD-P was 8 (Anderson and Neumann 1996). The catch rate was 160 bass/h for 12 h of electrofishing (Appendix). In 2003, 108 bass/h were collected during spring bass sampling. Growth was slightly lower than in 2003 (Figure 3). The size structure of the population has increased since 2003 when the bass PSD was 32, RSD-P was 6 and RSD-Q was 1.

Based on the 2003 angler creel survey there was an estimated 759 bass harvested. The 2006 population estimate of stock size bass (8.0 in) and greater was 7,295 bass. Dividing the 2006 bass population estimate by the 2003 bass harvest resulted in an exploitation rate of 10%. Annual mortality estimates were obtained by the Robson Chapman method, catch-curve analysis (Ricker 1975). In 2006, total bass mortality was 37.2% ( $\pm 1.5\%$ ). The natural mortality, based on maximum age of fish observed and the percentage of fish surviving to that age, was estimated using FAST software. Natural mortality was 25%. Subtracting total bass mortality from natural mortality gives an estimated bass exploitation of 12%. This model was also confirmed when the 2006 bass population estimate was divided by the 2003 harvest data for bass, giving an exploitation rate of 10%.

In order to determine if the bass population estimate would be acceptable when compared to a complete shoreline mark and recapture estimate, historic bass data was analyzed and recalculated to create a population estimate using approximately the same percentage (61%) of sample sites. A bass population estimate of Lenape Lake, Sullivan and Greene Counties (Schoenung 2003) was used to compare methods. Eight, 15-min stations were used to sample the entire shoreline of this lake. Five trial runs were conducted where 60% of the stations were randomly picked and expanded to encompass all the stations. All of the estimates in the trials fell within the standard error of the original survey (Figure 4). Ideally, when doing a mark and recapture population estimate the entire shoreline should be sampled. However, when personnel and time restrictions

are an issue, subsampling and expanding to encompass the entire shoreline is a viable option. Future mark and recapture largemouth bass population estimates using this method should focus more on length of stations rather than minutes of electrofishing. Larger stations that cover more uninterrupted shorelines would produce better results than randomly picking 1/2 mi stations. An unknown with this method is how many fish move in and out of the sample sites. A verification test should be conducted to determine if there is considerable movement of fish in and out of the sample sites.

In 2003, the report recommendation was to pursue a minimum size limit change at Sullivan Lake for largemouth bass from 14 to 16 in TL. If a 16-in minimum size limit was implemented, there would be a 24% decrease in bass yield. The number of fish in the population at 16 in and greater would increase by approximately 19%. Based on the population estimate this would provide a minimal increase by number. Currently there are 0.76 bass per acre 16 in and greater. A 16 in size limit would increase that to 0.9 bass per acre or approximately 65 fish. A gizzard shad forage base can be highly variable and as a result recruitment of all species in the system are affected. The change in size limit may not consistently improve numbers if poor recruitment occurs. Bass growth may also decline if forage is limited and stockpiling of bass occurs. The slight decline in growth from 2003 to 2006 may be a result of inconsistent shad year classes. Currently, it takes 6.3 years to produce a 16 in bass. In 2003, among all angling groups, only 18% supported a higher bass size limit. Among anglers specifically targeting largemouth bass, approximately 45% supported a higher size limit. At this time it does not appear that a size limit change would drastically improve the bass population. It also appears that there is not overwhelming public support for a size limit increase. The past recommendation to increase the size limit on bass will not be pursued.

## RECOMMENDATIONS

- Future bass population estimates using this method should be based on distance rather than time to determine sample sites. Longer sampling transects would produce better results.
- Determine how much if any bass immigrate or emigrate in and out of the sample sites.

- Past recommendation to increase largemouth bass size limit will not be pursued.

#### LITERATURE CITED

- Anderson, R.O. and R.M. Neumann. 1996. Length, weight, and structural indices. 447-482pp in B.R. Murphy and D. W. Willis, editor. Fisheries techniques, 2<sup>nd</sup> edition. American Fisheries Society, Bethesda, Maryland.
- Kohler, C.C. and W.A. Hubert, editors. 1999. Inland fisheries management in North America, 2<sup>nd</sup> Edition. American Fisheries Society, Bethesda, MD. pp 136-137.
- Ricker, W.E. 1975. Computation and interpretation of biological statistics of fish populations. Bulletin 191, Fisheries Research Board of Canada, Ottawa.
- Schoenung, B.M. 2002. Evaluation of largemouth bass slot size limit at Lenape Lake
- Schoenung B.M. 2003. 2003, Fishing pressure and harvest at Sullivan Lake, Indiana Department of Natural Resources, Indianapolis.
- Schoenung B.M. 2001. 2002, Sullivan Lake fish management report, Indiana Department of Natural Resources, Indianapolis.
- Slipke, J.W. and M.J. Maceina. 2000. Fishery analysis and simulation tools. Auburn University, Auburn, Alabama

Submitted by: David S. Kittaka, Fisheries Biologist  
Date: March 8, 2007

Approved by: \_\_\_\_\_  
Brian M. Schoenung, Fisheries Supervisor  
Date: July 19, 2007



Figure 1. Largemouth bass sample sites, Sullivan Lake, 2006.



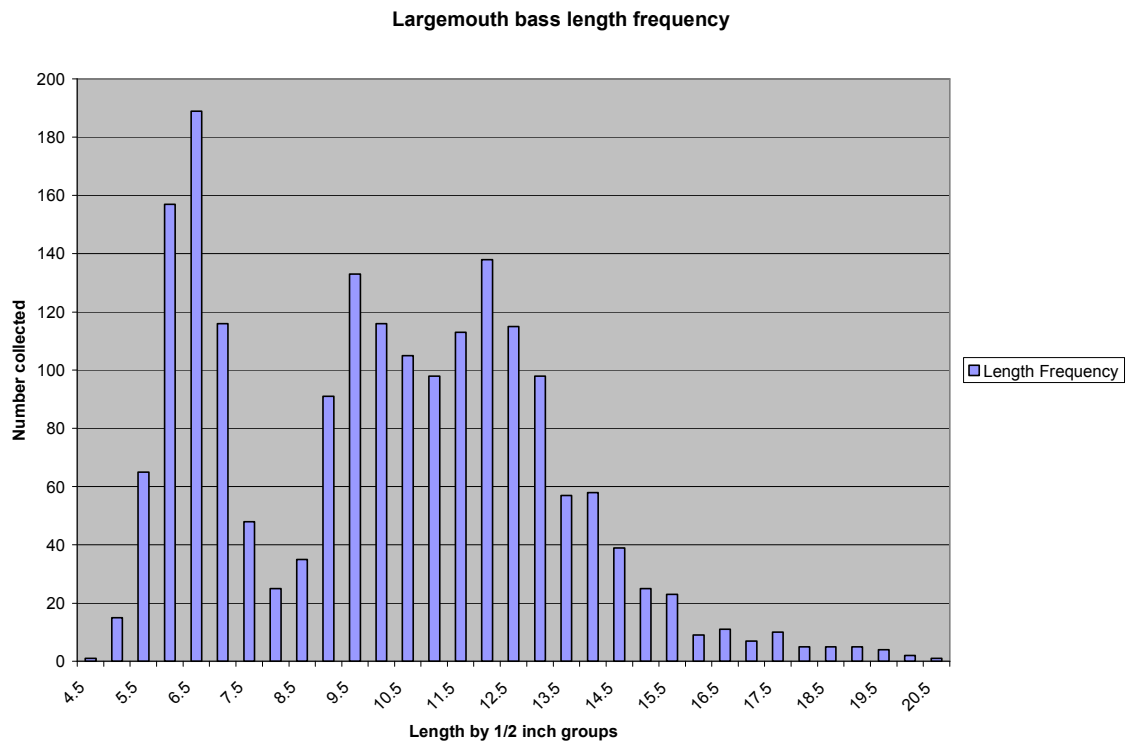


Figure 2. Length frequency of largemouth bass collect at Sullivan Lake, 2006.

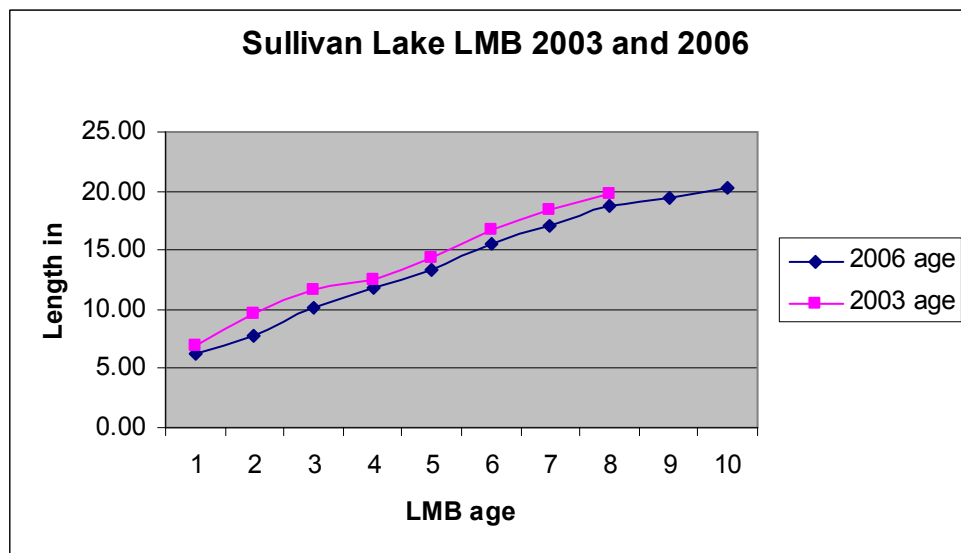


Figure 3. Mean length at age for largemouth bass aged from Sullivan Lake, 2003 and 2006.

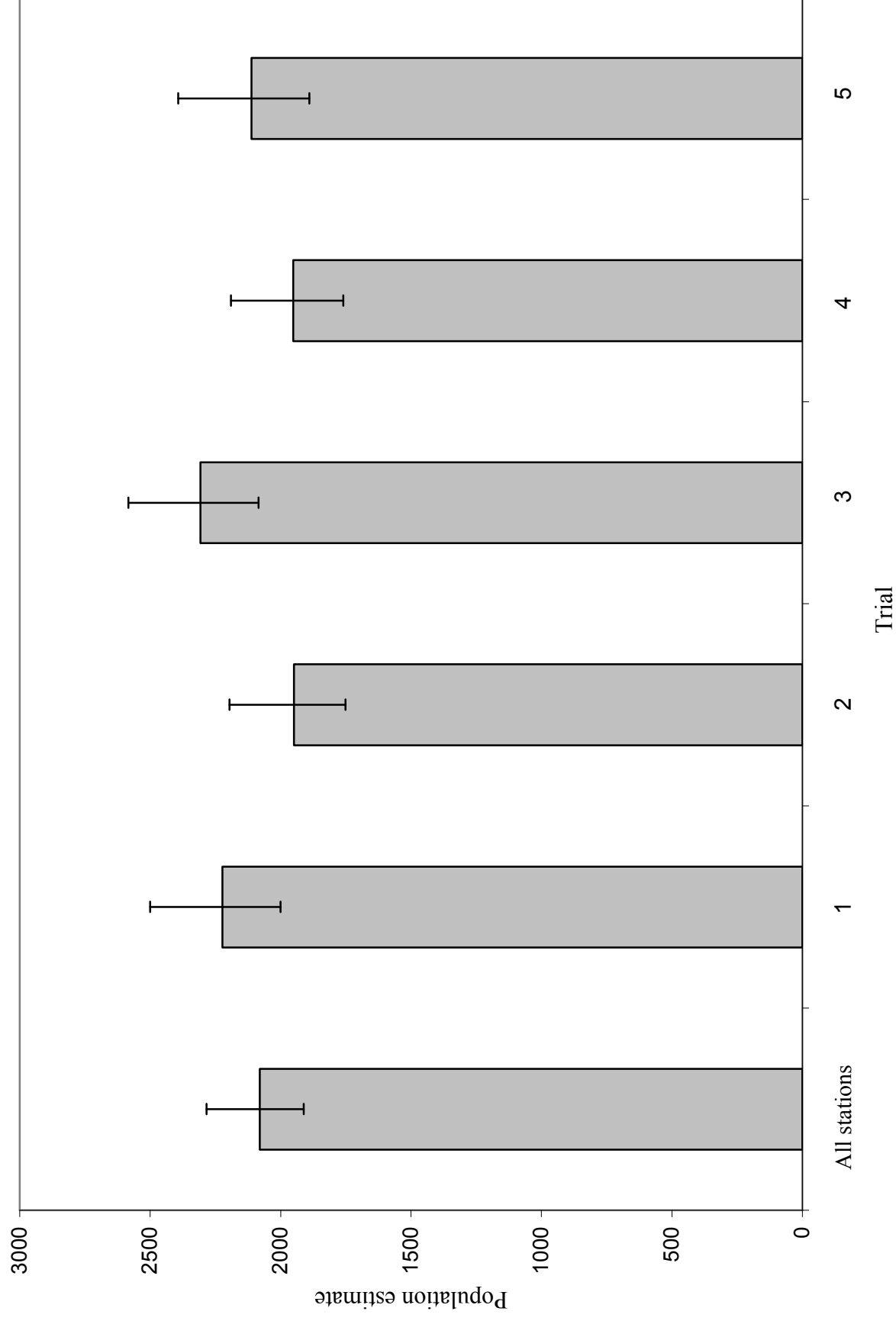


Figure 4. Largemouth bass population estimates for Lenape Lake. Five trial estimates using 60% of sample sites and expanding to estimate total bass population.

LAKE: Sullivan all stations				SIZE: All Bass						
CATCH	MARKED	RECAPTURES	C*M	POPULATION	ST ERR	SE %	95% LOW	95% HIGH	90% LOW	90% HIGH
356	0	0	148452	3159	461	14.6	2419	4305	2506	4055
417	356	46	224643	3520	342	9.7	2935	4301	3011	4149
309	727	59	355628	6810	658	9.7	5685	8314	5830	8021
364	977	1	548060	7173	538	7.5	6226	8358	6354	8137
409	1340	71	541994	6995	434	6.2	6218	7931	6326	7762
323	1678	82	0	6995	434	6.2	6218	7931	6326	7762
	1919		0							
	1919		0		434	6.2	6218	7931	6326	7762
SAMPLING RESULTS										
TOTAL RECAPTURES:			259	NOTE: If the sum of the recaptures is less than 51, enter the						
CATCH WITH RECAPS:			2178	Appendix values below to find the appropriate confidence limits.						
CATCH W/O RECAPS:			1919	COEFFICIENT	R LOW	R HIGH	POP LOW	POP HIGH		
PERCENT CAPTURED:			27.4%	0.95	0.0	0.0	1818777	1818777		
NIGHTLY EFFICIENCY:			5.2%							
LAKE: Sullivan all stations										
SIZE: >=Stock-size Bass										
CATCH	MARKED	RECAPTURES	C*M	POPULATION	ST ERR	SE %	95% LOW	95% HIGH	90% LOW	90% HIGH
281	0	0	82333	2167	351	16.2	1614	3068	1677	2864
293	281	37	103104	2347	264	11.3	1905	2967	1961	2842
192	537	41	180256	4629	521	11.3	3757	5851	3866	5604
262	688	0	294500	4854	416	8.6	4132	5788	4228	5610
310	950	57	246615	4489	316	7.0	3929	5180	4006	5053
205	1203	66	0	4489	316	7.0	3929	5180	4006	5053
	1342									
	1342		0	4489	316	7.0	3929	5180	4006	5053
SAMPLING RESULTS										
TOTAL RECAPTURES:			201	NOTE: If the sum of the recaptures is less than 51, enter the						
CATCH WITH RECAPS:			1543	Appendix values below to find the appropriate confidence limits.						
CATCH W/O RECAPS:			1342	COEFFICIENT	R LOW	R HIGH	POP LOW	POP HIGH		
PERCENT CAPTURED:			29.9%	0.95	0.0	0.0	906808	906808		
NIGHTLY EFFICIENCY:			5.7%							

<b>Lake:</b>	Sullivan Lake				<b>TN</b>	<b>GN</b>	<b>EF</b>
<b>Date:</b>	4/25/2006	to	5/9/2006	Total #	0	0	1919
<b>Species:</b>	Largemouth bass			Effort	0	0	12
<b>Total number:</b>	1919			CPUE			160
<b>Total weight:</b>	0						
<b>Length range:</b>	4.9	to	20.5				

Group	TL (in)	TN	GN	EF	TOTAL	RSD
Stock	8	0	0	1328	1328	-
Quality	12	0	0	612	612	46
Preferred	15	0	0	107	107	8
Memorable	20	0	0	3	3	0
Trophy	25	0	0	0	0	

Length group (in)	#	Mean weight (lbs)	Length group (in)	#	Mean weight (lbs)	Length group (in)	#	Mean weight (lbs)
1.0			17.5	10	0.00	34.0		
1.5			18.0	5	0.00	34.5		
2.0			18.5	5	0.00	35.0		
2.5			19.0	5	0.00	35.5		
3.0			19.5	4	0.00	36.0		
3.5			20.0	2	0.00	36.5		
4.0			20.5	1	0.00	37.0		
4.5	1	0.00	21.0			37.5		
5.0	15	0.00	21.5			38.0		
5.5	65	0.00	22.0			38.5		
6.0	157	0.00	22.5			39.0		
6.5	189	0.00	23.0			39.5		
7.0	116	0.00	23.5			40.0		
7.5	48	0.00	24.0			40.5		
8.0	25	0.00	24.5			41.0		
8.5	35	0.00	25.0			41.5		
9.0	91	0.00	25.5			42.0		
9.5	133	0.00	26.0			42.5		
10.0	116	0.00	26.5			43.0		
10.5	105	0.00	27.0			43.5		
11.0	98	0.00	27.5			44.0		
11.5	113	0.00	28.0			44.5		
12.0	138	0.00	28.5			45.0		
12.5	115	0.00	29.0			45.5		
13.0	98	0.00	29.5			46.0		
13.5	57	0.00	30.0			46.5		
14.0	58	0.00	30.5			47.0		
14.5	39	0.00	31.0			47.5		
15.0	25	0.00	31.5			48.0		
15.5	23	0.00	32.0			48.5		
16.0	9	0.00	32.5			49.0		
16.5	11	0.00	33.0			49.5		
17.0	7	0.00	33.5			50.0		

Lake: Sullivan Lake  
Date: 4/25/2006 to 5/9/2006  
Species: Largemouth bass

Age	Number	Mean TL	Var	SE	Lo 95%CI	Up 95%CI
1	329	6.3	0.26	0.03	6.3	6.4
2	410	7.9	1.38	0.06	7.7	8.0
3	335	10.1	0.54	0.04	10.0	10.2
4	358	11.9	0.69	0.04	11.8	12.0
5	372	13.3	1.22	0.06	13.2	13.4
6	82	15.5	1.38	0.13	15.3	15.8
7	18	17.1	4.31	0.50	16.1	18.0
8	12	18.8	1.06	0.30	18.1	19.4
9	2	19.4	2.78	1.11	17.1	21.6
10	2	20.3	0.00	0.00	20.3	20.3

Lake: Sullivan Lake  
 Date: 4/28/2003 to 4/28/2003  
 Species: Largemouth bass

Age	Number	Mean TL	Var	SE	Lo 95%CI	Up 95%CI	
1	55	6.9	0.51	0.1	6.7	7.1	4.007333
2	158	9.6	0.41	0.05	9.5	9.7	5.062595
3	112	11.6	0.57	0.07	11.5	11.7	4.718499
4	63	12.5	0.91	0.12	12.2	12.7	4.143135
5	29	14.4	0.66	0.15	14.1	14.7	3.367296
6	11	16.8	1.36	0.35	16.1	17.5	2.397895
7	6	18.4	0.24	0.19	18	18.7	1.791759
8	2	19.8	0	0	19.8	19.8	0.693147

Lake: Sullivan Lake  
 Date: 4/25/2006 to 5/9/2006  
 Species: Largemouth bass

Age	Number	Mean TL	Var	SE	Lo 95%CI	Up 95%CI	
1	329	6.33	0.26	0.03	6.27	6.39	
2	410	7.85	1.38	0.06	7.73	7.97	6.015453
3	335	10.11	0.54	0.04	10.03	10.19	5.814711
4	358	11.87	0.69	0.04	11.78	11.95	5.880643
5	372	13.33	1.22	0.06	13.21	13.44	5.918311
6	82	15.53	1.38	0.13	15.27	15.79	4.402233
7	18	17.05	4.31	0.50	16.06	18.05	2.862706
8	12	18.75	1.06	0.30	18.15	19.36	2.452646
9	2	19.36	2.78	1.11	17.14	21.58	0.81093
10	2	20.25	0.00	0.00	20.25	20.25	0.693147